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Tuesday, May 19, 2009

What caused the birth of agriculture and the industrial revolution?

Robin Hanson asks, "what key features make this [human] growth groove possible?" -- two key events being the birth of agriculture and the industrial revolution. Commenter "gwern" is on the money in saying that (a) explaining why the IR happened when and where it did is hard, and (b) the explanation has to include something that China didn't have much sooner, which eliminates most of the usual explanations. I'd add that explaning the birth of agriculture is even harder -- we have vast amounts of historical data on the IR and only archaeological and comparative anthropological evidence about the birth of agriculture.

Indeed, the most important thing in explaing these two events is to be aware of enough facts from different fields, and have sufficient doses of skepticism and common sense, that you can eliminate the many theories that are popular but obviously, if you know enough such things, wrong. For example, be aware that hunter-gatherers were experts on botany and animal behavior. It's not plausible that the simple ideas that seeds can grow into plants that you can eat later, or that you can keep an animal tied or penned up and eat it later, were not discovered and known countless times during the c. 100,000 years between when our brains became modern-sized and agriculture developed. There has to have been some major barrier to benefitting from such obvious ideas to have kept agriculture from developing far sooner. I also don't find genetics plausible as a cause of agriculture, since agriculture ended up spreading to a number of human groups that had become genetically isolated long before the dawn of agriculture. (Genetic evolution caused *by* agriculture is another story -- Cochran and Harpending have some ideas very much worth thinking about). Also not plausible are climate explanations -- there were many local climates hospitable to agriculture throughout those 100,000 years -- just not necessarily at Mediterranean or higher lattitudes.

That said, going back to the IR there a number of likely-to-firm differences between China and Western Europe (or Great Britain in particular):

(1) Differences in political and legal culture. What differences, specifically, it's hard to say, because there is very little about, for example, Sung or Ming dynasty commercial law that has been translated into English: far too little to compare to English law in the 18th century, for example. We know some very general things, such as that Western Europe was (and still is) a far more legalistic culture than China. Also, we know that Western Europe (contrary to Gregory Clark's claim) radically changed its property law between the 16th and 19th centuries, from a feudal model of of hierarchy of tenures and bundled political property rights to a model based on old Roman law with flattened and purely economic ownership. There ensued movements such as the enclosure movement in England and an accompanying large increase in capital investments in land. But we don't know when or to what extent similar incentives to capital investment might have been present or missing in China.

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Nick Szabo

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(2) China never controlled the world's oceans and merchant marine, but the British just prior and during its IR did. If this explains the IR, then to explain our explanation (i.e. why did Britain come to control the world's ocean-going trade) we have to step back and solve the even more puzzling question of how a tiny country of fishing-folk and small-time crusaders, Portugal, and not an advanced superpower like China, was the first country to take over most of the world's oceanic trade routes (later to be beaten back by other Western European countries and eventually Great Britain).

(3) China had the printing press, but in contrast to Western Europe it did not lead to a rapid growth in literacy sustained over several centuries -- perhaps because of bureaucratic central control rather than the free-enterprise printing businesses that sprung up all over Western Europe, perhaps because the much greater number of symbols did not as efficiently lend itself to printing as the Roman alphabet, or a combination of these two factors.

(The Romans were not all good -- indeed they gave our culture something quite nasty which I will blog on in the near future).

Other interesting related phenomenon to explain, (and it would be nice per Occam's Razor if it was the same general explanation, but social life is rarely that simple) is why Japan industrialized well in advance of China and Britain was a few decades ahead of the rest of Western Europe during most of the 18th and the first half of the 19th century.

Robin: "If you wanted to attribute the industrial revolution to writing, you'd have to explain why there was a strong threshold effect, so that pre-1800 writing levels had weak growth rate effects, while post-1800 writing levels had strong effects."

Besides threshold effects, there could be delay effects: for example, the the rapid growth of books and literacy after the mid-15th century in Western Europe gave rise to a slow but accelerating series of innovations (most obviously scientific and technological advances, but perhaps also innovations in business or law), which in turn gave rise to the IR.

Posted by Nick Szabo at 10:17 PM

12 comments:

Owen said...

Have you any comments on the Guns Germs and Steel theory of the origins of civilisation?

1:50 AM

nick said...

Owen: As a general comment, Diamond has had some valuable insights, but much of what he and other people that focus on variables such as climate, geology, and ecology do is "drunk looking under the lamp-post" kind of theorizing: they look at some less important factors that can be more easily studied by the non-social sciences and overstate their importance to social development.

Let's start with the "Germ" hypothesis. Assuming Diamond's big-arc causation big continent -> more domesticable plants and animals -> more diseases and immunities is true, that still doesn't explain most of the historically important differences, for example, why Spain and England rather than Arabia, India, China, Japan, or any number of cultures located on the coasts of Eurasia settled most of the disease-decimated New World. It also doesn't explain the relationship between Eurasia and Africa -- neither has been decimated by the diseases of the other anything like the New World was. And obviously it doesn't account for the many differences between

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different parts of Eurasia.

In short, the "Germs" theory is like a joke that is funny once -- it explains an important part of why aboriginal natives offered such weak resistance to the Europeans, but not much else of historical importance. (Yes, I know about the bubonic plague in 6th and 14th century Europe -- the historical consequences of these have been greatly overstated, IMHO, compared to more important but more difficult and subjective social explanations -- these are also examples of "drunk under the lamp-post" theorizing. For example, which I can go into more detail if there are strong requests, Mancur Olson's "roving bandit" theory is a far more important explanation of the Western European Dark Ages than the 6th century plague).

As for the "Steel" hypothesis (the "Guns" seems to be a poetic redundancy), Diamond from what I recall just presented a naked claim here -- he described no evidence at all that there was geologically better iron ores in Europe than in Near, South, East Asia or Africa or the Americas. As far as I know, that claim is geological nonsense, but if somebody can link to such evidence I'd be happy to look at it. (No, differences in steel production don't constitute evidence -- that is much more likely due to differences in technology or capital investment -- nor is evidence of proven reserves, since discovery and proof too are capital investments closely related to the technology. I'm looking for an actual study that accounts for differences in discovery efforts or gives some geological theory explaining why Europe was especially blessed at the formation of the earth or continents with iron ore).

An idea Diamond briefly put forth that Western Europe has more coastline and thus more ability to trade by sea strikes me as silly. Coastlines are fractal and how long the coastline is depends at what fractal scale you look at it. Diamond chose a scale that makes Europe's coasts look more ragged than China's. There are plenty of good harbors in every coastal region of Asia, and it was easier for China to build canals between its productive regions than England or most of Western Europe. (And they did build such canals long before England built its canals. But neither those canals nor its earlier inventions of printing, burning coal and refined oil, gunpowder, or a number of other things, caused China to go into an industrial revolution -- instead it stagnated until about two decades ago).

The most important explanations for historical differences between peoples are in order of importance (1) cultural differences, especially institutional differences in politics, law, and economics, (2) genetic differences, and (3) the "drunk under the lamp-post" differences popular among scientists such as climate, ecology, and geological endowment.

8:52 PM

Owen said...

Many thanks for your comprehensive reply. My distant memory of the book is of the geographical claim that Europe has the "critical mass" but also that the individual countries are more able to be easily defensible: he concludes that China, because of its geography, was far more likely to be a unitary state, so there wasn't the competition between states that drove European progress.

9:40 PM

nick said...

*the geographical claim that Europe has the "critical mass" but also that the individual countries are more able to be easily defensible*It's true that some geographies are, assuming something the size of a nation-state with a reasonable navy, cheaper to secure than others (e.g. Britain or Ireland than Western Europe, Japan or Taiwan than China), but I don't see how it distinguishes Europe from East Asia. There are plenty of geographically defensible areas in East Asia: the Korean Penninsula, Japan, Taiwan, the Phillipines, the Malay Penninsula, Indonesia, etc. Any of these could have played the role of tiny Portugal in conquering the world's trade routes if they'd had the appropriate culture. Why did Portugal capture Malacca instead of the Malaysians or Japanese or any other East or South Asian peoples capturing Gibraltar? Explain that, and we've probably also explained quite a bit about why the IR occurred in Western Europe rather than in East Asia.

We could think of Western Europe as something of a penninsula pinched a bit by the Adriatic and the Baltic, but with a brief and only loosely united exception (the Holy Roman Empire for a couple of centuries) this stretch was never defended by a single polity. Security-wise there's no difference between warring with each other, which European dukedoms, city-states, kingdoms, and nation-

states did aplenty, and warring with invaders from the Russian steppes or Turkey, or our hypothetical invaders from East or South Asia via the route around the south tip of Africa which never came.

1:28 AM

Daniel A. Nagy said...

What if that is no explanation beyond sheer luck (meaning, of course, a multitude of coinciding reasons that are impossible to discern)?

The IR happened relatively recently on a civilizational timescale and spread very rapidly. Maybe in a few thousand years it will be difficult to tell where it happened first.

As for agriculture, it is much more interesting, in my opinion: it represents a directional switch in co-evolution. The evolutionary pressure put on animals and plants that are hunted and gathered is making them more difficult to hunt and gather and also less nutritious and generally less useful for humans. The evolutionary pressure put on farm animals and cultivated plants is quite the opposite. However, there are many more examples of emerging cooperative co-evolution in nature, and I think the phenomenon would be best understood if approached in a general fashion. When learning about evolution as a kid, one of the first questions that I asked was why not all plants are poisonous cacti? Everything else should have been eaten long ago. The evolution of highly visible, easily-to-pick, tasty and nutritious fruit is another example of cooperative co-evolution (with whatever eats said fruit in exchange for planting and fertilizing the seed).

In short, I think that we need to understand the mechanism of the directional switch from hostile co-evolution (arms race) to cooperative co-evolution in general first and then we will be probably better armed for understanding the particularities of the emergence of agriculture.

2:25 AM

Daniel A. Nagy said...

I am often wondering whether we have a similar directional switching ahead of us with respect to fish in the oceans.

2:32 AM

Anonymous said...

Looking forward to both the "Romans were not all good" and the Mancur Olson posts.

11:40 AM

nick said...

Daniel, that's a very interesting comment. This switch sounds somewhat analogous to a peace treaty, which changes a relationship from coercive competition to cooperation (coercive, as in keeping animals penned up, or otherwise).

5:48 PM

Daniel A. said...

I think, the key to such switches is reserve-making. Like the rabbit-hole near the fox-hole: foxes do not hunt rabbits that live very close to them. The selective pressure on the fox here is that during really tough times the foxes that don't have rabbit-holes next to them starve. The selective pressure on rabbits is that really tough times are relatively infrequent, so it pays to live next to rational foxes.

I am pretty sure that the first cultivated plant was the last to be harvested.

1:16 PM

nick said...

Daniel, again very interesting. Can you recommend a good reference on reserve-making? Does a fox guard its rabbits from other foxes?

4:00 PM

Daniel A. Nagy said...

Unfortunately, I cannot. However, here is some information that might help in searching for sources:

For the first time, I learned about this phenomenon (rabbits living right next to fox-holes) as a child in the Zoology Museum in Leningrad (now St. Petersburg, Russia), listening to a fascinating lecture on ethology (for kids). It was not explicitly or implicitly connected to domestication.

Next, some ethology students of Queen's University (in Kingston, Ontario) actually pointed out traces of such co-habitation during our hikes in Canada, organized in the framework of the Outdoors Club, of which we were members. It was them, who told me about its importance in understanding domestication and also asked me to help them translate some papers published on the subject in the USSR. I think, they were referenced in a paper published in the early seventies titled "Citical Assessment of Soviet Ethology" or somesuch. Unfortunately, I do not remember the exact title.

In the USSR, considerable scientific effort was directed at domestication, though most of the results were negative, showing how difficult and slow this process is. One of the very few positive results is the domesticated silver fox; there are quite a few papers on the subject and some might have been translated into or published in English.

Both the game-theoretic aspects of such surprising U-turns in co-evolution and the actual genetic and physiological/ethological processes that embody them are very far from being properly understood as they are profoundly complex. The naive elementary-school narrative about the "invention" of agriculture is very wrong, that is for sure.

In general, the evolution of any behavior that pays in the long term at the expense of the short term (such as reserve making) is far from trivial. The environment in which it happens needs to be relatively forgiving for short-term sacrifices and very unforgiving for failure to consider the long-term. Otherwise, the short term always trumps the long term. Infrequent very harsh winters that sometimes happen where foxes and rabbits live, seem to have done the job of killing off the foxes that did not make reserves.

As for foxes, they are known to be territorial hunters (they do mark the boundaries), so of course they protect whatever lives on their territory (the closer to the fox hole, the more so) from other foxes. But territorial behavior evolves much earlier and easier; its evolution is relatively well understood, AFAIK (again, no references, sorry).

In short, I apologize for being so un-scholarly, but I did not really have an academic interest in the topic. I have always been fascinated by findings relayed to me by people who did such research, but not sufficiently to pursue this line of research with academic rigor myself.

9:09 AM

nick said...

No need to apologize -- my question stems solely from my own fascination with the idea and consequent desire to learn more. Thanks for the additional info.

3:19 AM

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